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A description of the demographic characteristics of the New Zealand non-commercial horse population with data collected using a generalised random-tessellation stratified sampling design

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ABSTRACT

We conducted a cross-sectional survey to determine the demographic characteristics of non-commercial horses in New Zealand. A sampling frame of properties with non-commercial horses was derived from the national farms database, AgriBase™. Horse properties were stratified by property size and a generalised random-tessellated stratified (GRTS) sampling strategy was used to select properties ($n = 2912$) to take part in the survey. The GRTS sampling design allowed for the selection of properties that were spatially balanced relative to the distribution of horse properties throughout the country. The registered decision maker of the property, as identified in AgriBase™, was sent a questionnaire asking them to describe the demographic characteristics of horses on the property, including the number and reason for keeping horses, as well as information about other animals kept on the property and the proximity of boundary neighbours with horses. The response rate to the survey was 38% (1044/2912) and the response rate was not associated with property size or region. A total of 5322 horses were kept for recreation, competition, racing, breeding, stock work, or as pets. The reasons for keeping horses and the number and class of horses varied significantly between regions and by property size. Of the properties sampled, less than half kept horses that could have been registered with Equestrian Sports New Zealand or either of the racing codes. Of the respondents that reported knowing whether their neighbours had horses, 58.6% (455/776) of properties had at least one boundary neighbour that kept horses. The results of this study have important implications for New Zealand, which has an equine population that is naïve to many equine diseases considered endemic worldwide. The ability to identify, and apply accurate knowledge of the population at risk to infectious disease control strategies would lead to more effective strategies to control and prevent disease spread during an exotic, infectious disease outbreak, but could also highlight groups within the population that require targeted surveillance.

1. Introduction

Outbreaks of infectious disease in domestic animal populations can have severe consequences in terms of productivity and animal welfare. The negative economic and welfare impacts associated with disease outbreaks can be reduced through the application of disease surveillance, control, treatment and prevention strategies that are targeted to high risk populations (Sanson, 2005; León et al., 2006). However, the success of these strategies is predicated on having a detailed knowledge of the demographic characteristics of the population at risk and where that population resides.

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In August 2007, the Australian equine population experienced its first outbreak of equine influenza (EI), leading to a national disease control effort (Callinan, 2008; Anon, 2009). The lack of knowledge regarding the susceptible population impeded control, particularly the effective implementation of vaccination (Cowled et al., 2009; Davis et al., 2009). Subsequent to the EI outbreak, the registration of horses on a central database has become mandatory in Australia for the purpose of informing disease control strategies during an outbreak.

Currently, New Zealand is in a similar situation to Australia prior to the EI outbreak, concerning the lack of availability of accurate demographic data regarding the equine population. Whilst the racing industry is important to New Zealand's economy and all horses involved in the industry must be registered (Anon, 2011), there is limited information about non-racing horses. Therefore, designing and then implementing effective treatment and control strategies for infectious disease outbreaks would be seriously inhibited by a lack of knowledge of the characteristics of the susceptible population, particularly horses not involved in the racing industry.

A major difficulty with obtaining data on the equine populations, particularly the non-racing or non-commercial sectors of the equine industry, has often been how to identify the properties or individuals of interest. Previous studies in the United Kingdom (Mellor et al., 1999; Ireland et al., 2011) and Australia (Cole et al., 2005) have selected horse owners through client lists from participating veterinary surgeries. Participants were selected randomly, based on the proportion of clients listed for each veterinary surgery as a proxy for spatial representation. This method of sample selection may have allowed for selection bias through the selection of a sample that was not representative of the underlying horse population. Not all horses or horse owners would have current registration with a veterinarian and not all veterinary surgeries were willing to participate. In countries like New Zealand, with a low level of endemic equine disease and a perceived low level of routine horse vaccination, the limitations of recruiting participants through veterinary surgeries are further exacerbated.

If an outbreak of EI was to occur in New Zealand, a nationwide effort to control and eradicate infection would be mounted. Therefore, spatially explicit demographic data would be required to inform disease controls strategies and to allow for control targeted at more at risk properties in the population. A common method used to select spatially balanced probability samples in the field of environmental science is the generalised random-tessellation stratified (GRTS) design Stevens and Olsen (2003, 2004). The emphasis of the GRTS sampling method is on selecting spatially balanced samples by accounting for the underlying spatial aggregation of the population of interest. A spatially balanced sample is achieved by using the geographic area as a selection variable, and selecting each individual in the sample based on the underlying population distribution. Random-tessellated sampling methods have been shown to be more effective than random sampling methods for the selection of spatially balanced samples (Barabesi and Franceschi, 2011; Grafstrom, 2012).

This paper is the first of a series of manuscripts regarding the collection of data for, and the development of, a model to evaluate the effectiveness of control strategies for EI in New Zealand. This paper presents a descriptive analysis of the demographic characteristics of the New Zealand non-commercial horse population and the methodology used to collect these data. The objective of this study was to identify the characteristics of the non-commercial equine population at the property-level, and to outline the importance of these characteristics in the context of the prevention and control of infectious disease. Property-level information included details of the number and type of horses kept, purposes horses were kept for, other animals kept on the property and the proximity of neighbours with horses. The spatial representativeness of the GRTS sampling method, when compared to the underlying population of non-commercial horse properties in this study, will also be evaluated.

2. Materials and methods

The study was a cross-sectional postal survey of premises defined as non-commercial horse properties, conducted in New Zealand in November 2009. Property data were obtained from the official agricultural property and livestock database (AgriBase™ 2008, AssureQuality Limited, New Zealand). This database is described as a national, spatial, multi-sectoral record of rural land use information in New Zealand, containing 105,000 rural properties. Properties in AgriBase™ were first identified through an agricultural census. The information in the database has been updated using a variety of sources including data collected directly from farmers and veterinarians, industry databases, such as Agricultural and Pastoral associations, and schemes to control tuberculosis and brucellosis (Sanson and Pearson, 1997; Sanson, 2005). From this database, 18,329 properties were identified as having horses.

2.1. Sampling frame

The AgriBase™ database classified horse properties into one of eight types: training or racing, breeding, work, sports, leisure, agistment (otherwise known as livery service or the keeping of horses for money), other and undifferentiated. Each horse property was classified as one type only. The focus of the survey was non-commercial and non-racing properties, therefore, properties identified in the dataset as breeding or training and racing were deemed ineligible for selection. Eligible properties were those classified in Agribase™ as work, sports, leisure, agistment and undifferentiated types and are subsequently referred to as non-commercial properties. Horse properties that were identified as being ineligible for selection were removed from the sampling frame. In total, 899 properties were identified as being racing or breeding properties and were excluded from selection, resulting in a sampling frame of 17,430 properties (Fig. 1A).